WHAT IS CLAIMED IS:

1.   A method of building an electronic database for data resolution synthesis from at least one training file, the method comprising the steps of:

generating a low-resolution file from each training file;

generating a plurality of representative vectors from each low-resolution

5   file; and

generating a set of interpolation filters for each of the representative vectors;

whereby the interpolation filters and the representative vectors can be used to perform data resolution synthesis on a file other than the training file.

2.   The method of claim 1, wherein the representative vectors are generated by computing a number NCV of cluster vectors from each low-resolution file and using the cluster vectors to compute the representative vectors; and wherein low-resolution observation vectors, the cluster vectors, the

5   representative vectors and a high-resolution file corresponding to each low-resolution file are used to compute the interpolation filters, whereby a high resolution file may be a training file.

3.   The method of claim 2, further comprising the step of generating a sharpened high-resolution file, the sharpened high-resolution file being used to compute the interpolation filters.

4.   The method of claim 2, wherein the representative vectors ar generated by using a maximum likelihood estimate.

5.   The method of claim 4, wherein the vectors are generated by using an expectation maximization technique.

6.   The m thod of claim 4, wherein a classifier including the representative v ctors is computed by initializing th classifier and updating the classifier until optimal values for the classifier have been obtained.

7.   The method of claim 6, wherein the classifier further includ s a variance and a number M of class weights, and wherein the representative vectors, the class weights and the variance are computed simultaneously.

8.   The method of claim 2, wherein each cluster vector is generat d by forming an observation window about sampled data in a low resolution file, extracting a vector including neighboring data of the sampled data, and scaling the vector.

9.   The method of claim 2, wherein coefficients for the interpolation filters are computed by:

computing a number NFDV of filter design triplets from data in the low-resolution file, where NFDV is a positive integer, each filter design triplet corresponding to sampled data in the low-resolution file, each filter design triplet including an observation vector for the sampled data, a cluster vector for the sampled data, and a vector of high resolution data from a high-resolution file;

computing training statistics from the filter design triplets; and

computing the coefficients from the training statistics.

10.   The method of claim 2, wherein the steps are run off-line in a computer.

11.   The method of claim 1, wherein the interpolation filters are linear filters.

12.   The m thod of claim 1, wherein the representative vectors are generated by using a parameter optimization technique.

13.   A method of using a computer to compute a plurality of resolution synthesis parameters from a training image, the method comprising the steps of:

computing a low-resolution image from the training image;

5   computing a plurality of cluster vectors for a number NCV of pixels in the low-resolution image, where NCV is a positive integer;

using the cluster vectors to compute a number M of representative vectors for the low resolution image, where M is a positive integer that is less than NCV; and

10   using low-resolution observation vectors, the cluster vectors, the representative vectors and vectors from a high-resolution image to compute sets of interpolation filter coefficients corresponding to each of the representativ vectors;

whereby the high-resolution image may be the training image; and

15   whereby the interpolation filter coefficients and the number M of representative vectors are stored in the database for later interpolation of an image other than the training image.

14.   The method of claim 13, wherein the number NCV is between 25,000 and 100,000, whereby between 25,000 and 100,000 cluster vectors are computed.

15.   The method of claim 13, wherein each cluster vector for a non-border pixel is computed by extracting a first vector from a square observation window centered about a sampled pixel in the low-resolution image, and scaling the first vector.

16.   Th method of claim 13, where the number M of r pres ntative vectors is between 50 and 100.

17.   The method of claim 13, wherein the representative vectors are computed using a maximum likelihood estimate.

18.   The method of claim 17, wherein a classifier including th representative vectors is computed by initializing the classifier and updating the classifier until optimal values for the classifier have been obtained.

19.   The method of claim 13, wherein the representative vectors are computed using an expectation-maximization algorithm.

20.   The method of claim 19, wherein the representative vectors are computed by:

setting initial values for a classifier including a number M of class weights, a variance and the number M of representative vectors;

5   computing a quality measure of how well the cluster vectors are represented by the initial values for the classifier;

updating the classifier;

recomputing the quality measure for the updated classifier; and

determining whether the cluster vectors are suitably represented by th

10   updated classifier, the classifier being updated until the cluster vectors are suitably represented.

21.   The method of claim 13, further comprising the st p of computing a sharpened high-resolution image from the training image, wherein the sharpened image is used along with low-resolution observation vectors, th cluster vectors and the representative vectors to compute the interpolation filter

5   coefficients.

22.   The method of claim 13, wherein the interpolation filter coefficients are computed by:

computing a number NFDV of filter design triplets from the low-resolution image, where NFDV is a positive integer, each filter design triplet corresponding

5   to a sampled pixel in the low-resolution image, each filter design triplet including an observation vector for the sampled pixel, a cluster vector for the sampled pixel, and a vector of high-resolution pixels corresponding to the sampled pixel, the high-resolution pixels being taken from the high-resolution image;

computing training statistics from the filter design triplets; and

10   computing the coefficients from the training statistics.

23.   The method of claim 22, wherein the number NFVD of filter design triplets is between 500,000 and 1,000,000, whereby between 500,000 and 1,000,000 filter design triplets are computed.

24.   The method of claim 22, wherein the interpolation filter coefficients are computed for linear interpolation filters.

25.   The method of claim 13, wherein the steps are run off-line in the computer.

26.   The method of claim 25, wherein the database is stored for transfer to a second computer, whereby the second computer can access the database to perform image interpolation on images other than the training images.

27.   The method of claim 25, wherein the database is stored in memory of a printer, whereby the printer can access the database to p rform image interpolation on images other than the training images.

28.   The method of claim 13, wherein the repres ntativ vectors are generated by using a parameter optimization technique.

29.   Apparatus comprising:

a processor; and

memory means for storing an electronic database and a plurality of executable instructions, the instructions, when executed, instructing the processor
5   to access a training file; generate a low-resolution file from the training fil ; generate a plurality of representative vectors from the low-resolution file; generate a set of interpolation filters for each of the representative vectors; and store the interpolation filters and the representative vectors in the memory means as part of the database.

30.   The apparatus of claim 29, wherein the instructions instruct the processor to generate the representative vectors by computing a number NCV of cluster vectors from the low-resolution file, and using the cluster vectors to
5   generate the representative vectors; and wherein the instructions instruct the processor to generate the interpolation filters from low-resolution observation vectors, the cluster vectors, the representative vectors and a plurality of vectors from a high-resolution file corresponding to the low-resolution file.

31.   The apparatus of claim 30, wherein the instructions further instruct the processor to generate a sharpened high-resolution file from the training file, the sharpened high-resolution file being used to comput the interpolation filters.

32.   The apparatus of claim 30, wherein the instructions instruct the processor to generate a classifier including the representative vectors by

initializing the classifier and updating the classifier until optimal values for the classifier have been obtained.

33.   The apparatus of claim 30, wherein the instructions instruct the processor to generate each cluster vector by forming an observation window about sampled data in the low-resolution file, extracting a vector including neighboring data of the sampled data, subtracting a value of the sampled data

5   from values of the data in the vector; and scaling the vector.

34.   The apparatus of claim 30, wherein the instructions instruct the processor to compute coefficients for the interpolation filters by:

computing a number NFDV of filter design triplets from data in the low-resolution file, where NFDV is a positive integer, each filter design triplet

5   corresponding to sampled data in the low-resolution file, each filter design triplet including an observation vector for the sampled data, a cluster vector for th sampled data, and a vector of high resolution data from a high-resolution fil , the high resolution data corresponding to the sampled data;

computing training statistics from the filter design triplets; and

10   computing the coefficients from the training statistics.

35.   The apparatus of claim 30, wherein the interpolation filters are linear filters.

36.   An article of manufacture for instructing a processor to compute a resolution synthesis database from a training image, the article comprising:

computer memory; and

a plurality of executable instructions stored in the computer memory, the

5   instructions, when executed, instructing the processor to compute a low-resolution image from the training image; compute a plurality of representative vectors from th low-resolution image; and comput a s t of int rpolation filt rs for ach of the

representative vectors; whereby the interpolation filters and the repres ntative vectors form a part of the database.

37. The article of claim 36, wherein the instructions instruct the processor to compute the representative vectors by computing a number NCV of cluster vectors from the low-resolution image, and using the cluster vectors to compute the representative vectors; and wherein the instructions instruct the

5 processor to compute the interpolation filters from low-resolution observation vectors, the cluster vectors, the representative vectors and vectors from a high-resolution image corresponding to the low-resolution image.

38. The article of claim 37, wherein the instructions further instruct the processor to compute a sharpened high-resolution image from the training image, the sharpened high-resolution file being used to compute the interpolation filters.

39. The article of claim 37, wherein the instructions instruct the processor to compute a classifier including the representative vectors by initializing the classifier and updating the classifier until optimal values for the classifier have been obtained.

40. The article of claim 37, wherein the instructions instruct the processor to compute each cluster vector by forming an observation window about a sampled pixel in the low-resolution image, extracting a vector including neighboring pixels of the sampled pixel, subtracting a value of the sampled pixel

5 from values of the pixels in the vector; and scaling the vector.

41. The article of claim 37, wherein the instructions instruct the processor to compute coefficients for the interpolation filters by:

computing a numb r NFDV of filter design triplets from pix ls in th low-resolution image, where NFDV is a positive integ r, ach filt r design triplet

5   corresponding to a sampled pixel in the low-resolution image, each filter design triplet including an observation vector for the sampled pixel, a cluster vector for the sampled pixel, and a vector of high resolution pixels from a high-resolution image, the high resolution pixels corresponding to the sampled pixel;

computing training statistics from the filter design triplets; and

10   computing the coefficients from the training statistics.

42.   The article of claim 36, wherein the representative vectors are generated by using a parameter optimization technique.

43.   An article of manufacture comprising:

computer memory; and

a database encoded in the computer memory, the database including a plurality of sets of resolution synthesis parameters, each set corresponding to an

5   interpolation factor, each set including a classifier and a number M of resolution synthesis filters, each classifier including a number M of representative vectors, where M is a positive integer.

44.   The article of claim 43, wherein each classifier further includes a variance and a number M of class weights.

45.   The article of claim 43, wherein the number M is between 50 and 100.